Indiana Department of Education
Dr. Katie Jenner, Secretary of Education

Indiana Academic Standards
Mathematics
Vertical Articulation: Grades 5-6

Introduction

The Indiana Academic Standards for mathematics are the result of a process designed to identify, evaluate, synthesize, and create the highest quality, rigorous standards for Indiana students. The standards are designed to ensure that all Indiana students are prepared for both college and career opportunities upon graduation. In alignment with Indiana's plan under the Every Student Succeeds Act (ESSA), the standards reflect the core belief that all students are capable of high-level achievement.

What are the Indiana Academic Standards?

The Indiana Academic Standards are designed to help educators, parents, students, and community members understand what students need to know and be able to do at each grade level, and within each content strand, in order to exit high school college- and career-ready. The academic standards should form the basis for strong Tier 1 instruction at each grade level and for each content area for all students, in alignment with Indiana's vision for Multi-Tiered Systems of Supports (MTSS). While the standards have identified the academic content or skills that Indiana students need to be prepared for both college and career, they are not an exhaustive list. Students require a wide range of physical, social, and emotional support to be successful. This leads to a second core belief outlined in Indiana's ESSA plan that learning requires an emphasis on the whole child.

While the standards may be used as the basis for curriculum, the Indiana Academic Standards are not a curriculum. Curricular tools, including textbooks, are selected by the corporation/school and adopted through the local school board. However, a strong standards-based approach to instruction is encouraged, as most curricula will not align perfectly with the Indiana Academic Standards. Additionally, attention should be given at the corporation- and school-level to the instructional sequence of the standards as well as to the length of time needed to teach each standard. Every standard has a unique place in the continuum of learning - omitting one will certainly create gaps - but each standard will not require the same amount of time and attention. A deep understanding of the vertical articulation of the standards will enable educators to make the best instructional decisions. The Indiana Academic Standards must also be complemented by robust, evidence-based instructional practices, geared to the development of the whole child. By utilizing well-chosen instructional practices, social-emotional competencies and employability skills can be developed in conjunction with the content standards.

What is the purpose of a Vertical Articulation Guide?

A Vertical Articulation Guide serves to support educators in planning instruction that builds upon foundational skills and leads to more advanced skills. This document demonstrates how each standard progresses between each grade level. Educators may use this document to guide instructional practices for remediation or enrichment and develop curriculum maps for each grade level.

Academic Impact

The COVID-19 pandemic has significantly impacted student learning. Students experienced moderate to significant impacts that require more than one year of supplemental academic support to recover the impact. Most students were impacted academically. Review additional information on the Executive Summary of the Indiana Academic Impact Analysis here.

Mathematics - *Number Sense*	
GRADE 5	**GRADE 6**
5.NS.1 Use a number line to compare and order fractions, mixed numbers, and decimals to thousandths. Write the results using >, =, and < symbols.	**6.NS.3:** Compare and order rational numbers and plot them on a number line. Write, interpret, and explain statements of order for rational numbers in real-world contexts.
5.NS.2 Explain different interpretations of fractions, including as parts of a whole, parts of a set, and division of whole numbers by whole numbers.	
5.NS.3 Recognize the relationship that in a multi-digit number, a digit in one place represents 10 times as much as it represents in the place to its right, and inversely, a digit in one place represents 1/10 of what it represents in the place to its left.	
5.NS.4 Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10.	
5.NS.5 Use place value understanding to round decimal numbers up to thousandths to any given place value.	
5.NS.6 Understand, interpret, and model percents as part of a hundred (e.g., by using pictures, diagrams, and other visual models).	**6.NS.5** Know commonly used fractions (halves, thirds, fourths, fifths, eighths, tenths) and their decimal and percent equivalents. Convert between any two representations (fractions, decimals, percents) of positive rational numbers without the use of a calculator.
	6.NS.1: Understand that positive and negative numbers are used to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge). Use positive and negative numbers to represent and compare quantities in real-world contexts, explaining the meaning of zero in each situation.
	6.NS.2: Recognize opposite signs of numbers as indicating locations on opposite sides of zero on the number line; recognize that the opposite of a number is the number itself (e.g., –(–3) = 3), and that zero is its own opposite.
	6.NS.4 Understand that the absolute value of a number is the distance from zero on a number line. Find the absolute value of real numbers and know that the

	distance between two numbers on the number line is the absolute value of their difference. Interpret absolute value as magnitude for a positive or negative quantity in a real-world situation.
	6.NS.6 Identify and explain prime and composite numbers.
	6.NS.7 Find the greatest common factor of two whole numbers less than or equal to 100 and the least common multiple of two whole numbers less than or equal to 12. Use the distributive property to express a sum of two whole numbers from 1 to 100, with a common factor as a multiple of a sum of two whole numbers with no common factor.
	6.NS.8 Interpret, model, and use ratios to show the relative sizes of two quantities. Describe how a ratio shows the relationship between two quantities. Use the following notations: a/b, a to b, a:b.
	6.NS.9 Understand the concept of a unit rate and use terms related to rate in the context of a ratio relationship.
	6.NS.10 Use reasoning involving rates and ratios to model real-world and other mathematical problems (e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations).

Mathematics - *Computation*	
GRADE 5	**GRADE 6**
5.C.1 Multiply multi-digit whole numbers fluently using a standard algorithmic approach.	**6.C.1** Divide multi-digit whole numbers fluently using a standard algorithmic approach.
5.C.2 Find whole-number quotients and remainders with up to four-digit dividends and two-digit divisors, using strategies based on place value, the properties of operations, and/or the relationship between multiplication and division. Describe the strategy and explain the reasoning used.	**6.C.2** Compute with positive fractions and positive decimals fluently using a standard algorithmic approach..
5.C.3 Compare the size of a product to the size of one factor on the basis of the size of the other factor, without performing the indicated multiplication.	**6.C.3** Solve real-world problems with positive fractions and decimals by using one or two operations.

5.C.4 Add and subtract fractions with unlike denominators, including mixed numbers.	
5.C.5 Use visual fraction models and numbers to multiply a fraction by a fraction or a whole number.	**6.C.5** Evaluate positive rational numbers with whole number exponents.
5.C.6 Explain why multiplying a positive number by a fraction greater than one results in a product greater than the given number. Explain why multiplying a positive number by a fraction less than one results in a product smaller than the given number. Relate the principle of fraction equivalence, a/b = (n x a)/(n x b), to the effect of multiplying a/b by one.	**6.C.6** Apply the order of operations and properties of operations (identity, inverse, commutative properties of addition and multiplication, associative properties of addition and multiplication, and distributive property) to evaluate numerical expressions with nonnegative rational numbers, including those using grouping symbols, such as parentheses, and involving whole number exponents.
5.C.8 Add, subtract, multiply, and divide decimals to hundredths, using models or drawings and strategies based on place value or the properties of operations. Describe the strategy and explain the reasoning.	
5.C.9 Evaluate expressions with parentheses or brackets involving whole numbers using the commutative properties of addition and multiplication, associative properties of addition and multiplication, and distributive property.	

Mathematics - *Algebraic Thinking/Functions*	
GRADE 5	**GRADE 6**
5.AT.1 Solve real-world problems involving multiplication and division of whole numbers (e.g., by using equations to represent the problem). In division problems that involve a remainder, explain how the remainder affects the solution to the problem.	
5.AT.2 Solve real-world problems involving addition and subtraction of fractions referring to the same whole, including cases of unlike denominators (e.g., by using visual fraction models and equations to represent the problem). Use benchmark fractions and number sense of fractions to estimate mentally and assess whether the answer is reasonable.	
5.AT.3 Solve real-world problems involving multiplication of fractions, including mixed numbers (e.g., by using visual fraction models and equations to represent the problem).	

5.AT.4 Solve real-world problems involving division of unit fractions by non-zero whole numbers, and division of whole numbers by unit fractions (e.g., by using visual fraction models and equations to represent the problem).	
5.AT.5 Solve real-world problems involving addition, subtraction, multiplication, and division with decimals to hundredths, including problems that involve money in decimal notation (e.g., by using equations, models or drawings and strategies based on place value or properties of operations to represent the problem).	
5.AT.6 Graph points with whole number coordinates on a coordinate plane. Explain how the coordinates relate the point as the distance from the origin on each axis, with the convention that the names of the two axes and the coordinates correspond (e.g., x-axis and x-coordinate, y-axis and y-coordinate).	**6.AF.7** Understand that signs of numbers in ordered pairs indicate the quadrant containing the point. Identify rules or patterns in the signs as they relate to the quadrants. Graph points with rational number coordinates on a coordinate plane.
5.AT.7 Represent real-world problems and equations by graphing ordered pairs in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation.	**6.AF.8** Solve real-world and other mathematical problems by graphing points with rational number coordinates on a coordinate plane. Include the use of coordinates and absolute value to find distances between points with the same first coordinate or the same second coordinate.
	6.GM.3 Draw polygons in the coordinate plane given coordinates for the vertices; use coordinates to find the length of a side joining points with the same first coordinate or the same second coordinate; apply these techniques to solve real-world and other mathematical problems.
5.AT.8 Define and use up to two variables to write linear expressions that arise from real-world problems, and evaluate them for given values	**6.AF.1:** Evaluate expressions for specific values of their variables, including expressions with whole-number exponents and those that arise from formulas used in geometry and other real-world problems.
	6.AF.2: Apply the properties of operations (e.g., identity, inverse, commutative, associative, distributive properties) to create equivalent linear expressions and to justify whether two linear expressions are equivalent when the two expressions name the same number regardless of which value is substituted into them.
	6.AF.3: Define and use multiple variables when writing expressions to represent real-world and other mathematical problems, and evaluate them for given values.
	6.AF.4 Understand that solving an equation or inequality is the process of answering the following question: Which values from a specified set, if any, make

	the equation or inequality true? Use substitution to determine whether a given number in a specified set makes an equation or inequality true.
	6.AF.5: Solve equations of the form x + p = q, x - p = q, px = q, and x/p = q fluently for cases in which p, q, and x are all nonnegative rational numbers. Represent real world problems using equations of these forms and solve such problems
	6.AF.6: Write an inequality of the form x > c, x ≥ c, x < c, or x ≤ c, where c is a rational number, to represent a constraint or condition in a real-world or other mathematical problem. Recognize inequalities have infinitely many solutions and represent solutions on a number line diagram.
	6.AF.9 Make tables of equivalent ratios relating quantities with whole-number measurements, find missing values in the tables, and plot the pairs of values on the coordinate plane.
	6.AF.10: Use variables to represent two quantities in a proportional relationship in a real-world problem; write an equation to express one quantity, the dependent variable, in terms of the other quantity, the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation.

Mathematics - *Geometry and Measurement*	
GRADE 5	**GRADE 6**
5.G.1: Identify, describe, and draw triangles (right, acute, obtuse) and circles using appropriate tools (e.g., ruler or straightedge, compass and technology). Understand the relationship between radius and diameter.	**6.GM.2** Know that the sum of the interior angles of any triangle is 180º and that the sum of the interior angles of any quadrilateral is 360º. Use this information to solve real-world and mathematical problems.
5.G.2: Identify and classify polygons including quadrilaterals, pentagons, hexagons, and triangles (equilateral, isosceles, scalene, right, acute and obtuse) based on angle measures and sides. Classify polygons in a hierarchy based on properties.	
5.M.1 Convert among different-sized standard measurement units within a given measurement system, and use these conversions in solving multi-step real-world problems.	**6.GM.1** Convert between measurement systems (English to metric and metric to English) given conversion factors, and use these conversions in solving real-world problems.

5.M.2 Find the area of a rectangle with fractional side lengths by modeling with unit squares of the appropriate unit fraction side lengths, and show that the area is the same as would be found by multiplying the side lengths. Multiply fractional side lengths to find areas of rectangles, and represent fraction products as rectangular areas.	**6.GM.4** Find the area of complex shapes composed of polygons by composing or decomposing into simple shapes; apply this technique to solve real-world and other mathematical problems. **6.GM.6** Construct right rectangular prisms from nets and use the nets to compute the surface area of prisms; apply this technique to solve real-world and other mathematical problems.
5.M.3 Develop and use formulas for the area of triangles, parallelograms and trapezoids. Solve real-world and other mathematical problems that involve perimeter and area of triangles, parallelograms and trapezoids, using appropriate units for measures.	
5.M.4 Find the volume of a right rectangular prism with whole-number side lengths by packing it with unit cubes, and show that the volume is the same as would be found by multiplying the edge lengths or multiplying the height by the area of the base.	**6.GM.5** Find the volume of a right rectangular prism with fractional edge lengths using unit cubes of the appropriate unit fraction edge lengths (e.g., using technology or concrete materials), and show that the volume is the same as would be found by multiplying the edge lengths of the prism. Apply the formulas V = lwh and V = Bh to find volumes of right rectangular prisms with fractional edge lengths to solve real-world and other mathematical problems.
5.M.5 Apply the formulas V = l × w × h and V = B × h for right rectangular prisms to find volumes of right rectangular prisms with whole-number edge lengths to solve real-world problems and other mathematical problems.	
5.M.6 Find volumes of solid figures composed of two non-overlapping right rectangular prisms by adding the volumes of the non-overlapping parts, applying this technique to solve real-world problems and other mathematical problems.	

Mathematics - *Data Analysis*	
GRADE 5	**GRADE 6**
5.DS.1 Formulate questions that can be addressed with data and make predictions about the data. Use observations, surveys, and experiments to collect, represent, and interpret the data using tables (including frequency tables), line plots, bar graphs, and line graphs. Recognize the differences in representing categorical and numerical data.	**6.DS.1** Recognize a statistical question as one that anticipates variability in the data related to the question and accounts for the variability in the answers. Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape.
	6.DS.2 Select, create, and interpret graphical representations of numerical data, including line plots, histograms, and box plots.

	6.DS.3 Formulate statistical questions; collect and organize the data (e.g., using technology); display and interpret the data with graphical representations (e.g., using technology).
5.DS.2 Understand and use measures of center (mean and median) and frequency (mode), to describe a data set.	**6.DS.4:** Summarize numerical data sets in relation to their context in multiple ways, such as: report the number of observations; describe the nature of the attribute under investigation, including how it was measured and its units of measurement; determine quantitative measures of center (mean and/or median) and spread (range and interquartile range); describe any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered; relate the choice of measures of center and spread to the shape of the data distribution and the context in which the data were gathered.